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ABSTRACT

This paper presents a theory of instructional text design that takes into account the process of reading comprehension and the variables in both the reader and the text which can affect that process. Three areas of design concern--legibility and readability, visual illustration, and structure and organization--are discussed. Each area design concern is considered as contributing either to the "interactivity" of the process or to the structure and organization aspect of acquired knowledge in memory. A unifying theory incorporating all three areas of concern is then presented which is based on findings of prior research that: (1) reading is an interactive process between reader and text; (2) the process is contributed to by characteristics of both the text and the reader; and (3) knowledge in memory is highly structured and organized. It is argued that, given these factors, design elements of the text can be manipulated to ensure that existing knowledge in the reader can be activated so that new knowledge presented in the text in a structured and organized way and appropriately highlighted through verbal and typographic cuing supported, as required, by visual illustration and organization, can be assimilated in a manner facilitative of reading comprehension. One diagram is provided. (28 references) (EW)

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Towards a theory of instructional text design

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Towards a theory of instructional text design

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Introduction

Perhaps it is because text is such a ubiquitous part of the teaching/learning environment that those who use it for instruction appear to do so without any consideration for its design to facilitate learning. Yet it cannot be assumed, as Cunningham *et al* (1981) have pointed out, that meaning lies on a page and must somehow be lifted from the page into the mind of the reader. It is clear, rather, that the way text is comprehended and remembered is a function of both the structure of the text and the knowledge utilised by the individual (Voss & Bisanz, 1985). In approaching the design of text as an instructional medium, therefore, the instructional designer or instructional materials developer has to have a clear understanding of the process of reading comprehension and the variables in both the reader and the text which can affect that process (Stewart, 1987).

Reading comprehension is an interactive process between text-based ideas and reader-based schemata where the greater the correspondence between the text and the prior knowledge of the reader the more efficient will be the comprehension (Stewart, 1986). Individual differences in reading performance can arise from factors in bottom-up (or text-based) processing, top-down (or knowledge-based) processing, the interaction of top-down and bottom-up processing, and the metacognitive control processes that manage the entire system (Spiro & Myers, 1984). Purpose, world knowledge, cognitive and metacognitve skills, and imagery ability have been identified as some of the inherent characteristics of the reader which have to be taken into consideration by the instructional designer or instructional materials developer (Stewart, 1986), although they cannot be controlled by the designer. Control can, however, be exerted over design aspects of the text such that they can be manipulated within a framework of identified principles in order to facilitate comprehension. Understanding of these principles should enable the instructional designer/developer either to work from first principles to develop acceptable practice or to examine current practice against the criteria of identified principles and a theory of instructional text design to which they contribute.

The bases for a theory

There is, at present, no single theory of learning from text which would enable the outlining of a theory of instructional text design. What exists is a number of theories relating to how people learn from text, the most fundamental of which are those emanating from cognitive psychology regarding the interactive nature of the reading process and the structured and organised nature of knowledge in memory. These, of themselves, do not constitute a theory of instructional text design but they do provide a focus on which such a theory can be built. Stewart (1986) has identified areas of design concern - legibility & readability, visual illustration, and structure & organisation - and has derived principles in relation to these areas, with particular relevance to the cognitive psychology theories mentioned above, in an attempt to determine ways in which there could be a contribution to the structured and

1743

organised nature of knowledge acquisition within a framework of the interactive nature of the reading process. Each area of design concern was considered as contributing either to the 'interactivity' of the process or to the structure & organisation aspect of acquired knowledge in memory. A unifying theory can be developed from these considerations in which it is clear that, since, (a) reading is an interactive process between reader and text, (b) the process is contributed to by characteristics of both the text and the reader, and (c) knowledge in memory is highly structured and organised, design elements of the text can be manipulated to ensure that existing knowledge in the reader can be activated so that new knowledge presented in the text in a structured and organised way and appropriately highlighted through verbal and typographic cueing supported, as required, by visual illustration and organisation can be assimilated in a manner facilitative of comprehension.

Before outlining the nature of the emerging theory it is appropriate to consider the contribution to that theory from the identified areas of design concern.

Structure & organization

Winne (1985) has noted that information in permanent memory is highly organised and can be pictured as a complex network or a hierarchical array, with three basic forms of information being theorised – concepts, propositions, and schema. Not only are the forms of information organised; they achieve meaning by their relationships to one another. Brandt (1978) has argued that the content and structure of passages of text are inextricably linked and that students will learn better from text if they can follow the organisation of the material and later use that organisation. Glynn & Britton (1984) have suggested that, since comprehension of text can be a cognitively demanding task, authors can help readers to comprehend and recall text information by making sure that the design of their text supports each of the component comprehension processes that the readers must perform, including, *inter alia*, identifying the important ideas in the text, organising those ideas, and integrating them with prior knowledge.

Armbruster & Anderson (1985) found that, before text organisation became clear to them, it was necessary to analyse the underlying organisation of the content of the material. This emphasis on content analysis should hardly be surprising for the designer of instructional text since a prerequisite to the design of instructional materials must necessarily be a task or topic analysis. What is needed is, in essence, an analysis of a topic to find the logical heirarchical relations in the topic so that instruction can be sequenced accordingly (Tiemann & Markle, 1985). The first step within the structure & organisation area of design concern must, therefore, be the carrying out of a topic analysis.

Such a topic analysis not only clarifies the hierarchic relationships within the topic, but provides the basis for identifying the desired learning outcomes or objectives. Glynn et al (1985) have indicated that the organisation of text can be made explicit through both verbal and typographical cueing systems. It has been postulated by Stewart (1986) that the statement of a high-level learning outcome as an objective in advance of reading will lead the reader to adopt a "deep approach" (Dahlgren, 1984) to the reading of the passage. Since such an outcome can also be achieved by the insertion in text of higher-level questions, it is suggested that, in practice the high-level learning outcome can be stated in advance of the passage of text and high-level questions related to the stated learning outcome can be

included within the text. Thus, the clarification of learning outcomes or objectives enables the instructional designer/developer to decide what kind of verbal cueing or pre-instructional strategy can be used to help the reader to recognise the desired outcome and adopt an appropriate approach to the reading task. It also allows the designer to give consideration to the formulation of the in-text questions of an appropriate type and level.

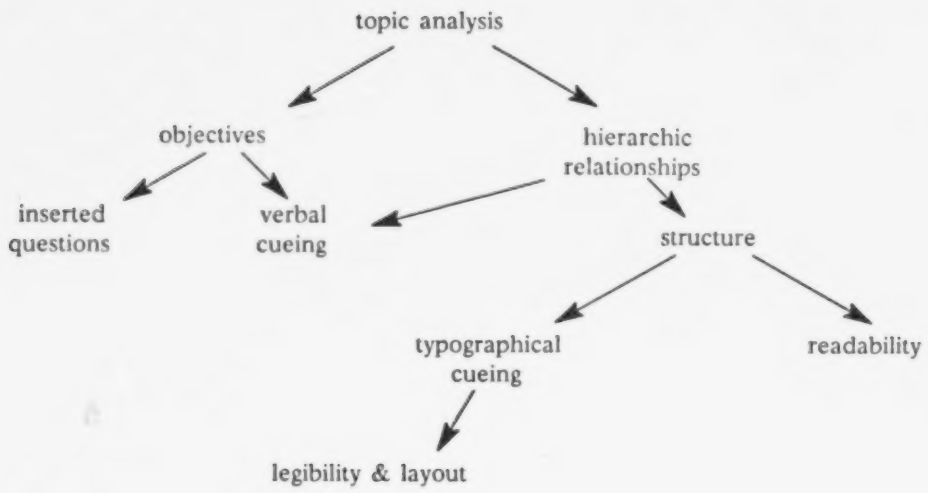
The topic analysis exercise, in clarifying the hierarchic relationship, enables the instructional designer or instructional materials developer also to consider the kind of verbal cueing necessary in relation to any advance organizer which must reflect the structure & organisation of the text and alert the reader to relevant schema-activation. Stewart (1986) has suggested the principle that, if the reader is oriented by a brief verbal organizer toward the application of existing knowledge to the assimilation of the main features of new knowledge in text, comprehension of that new knowledge will be facilitated. Application of this principle requires an emphasis on the activation of existing knowledge which is really guidance to the reader and is an extension or broadening of the concept of advance organizer.

The verbal cueing arising from the topic analysis thus allows an integration of learning outcome and overview of structure together with schema activation and establishment of a deep-approach set to learn.

Clarification of the hierarchic relationship provides, additionally, the basis for the determination of the structure of the text and from that can be developed the verbal and typographical cueing necessary to make explicit the structure. It is clear from the work of Singer (1985) and Meyer (1981, 1985) that there are organisational features of text which, if recognised and used by students, can lead to better process and recall of information, and Stewart (1986) proposed a principle of textual structure & organisation which deduced that, if the critical information to be communicated is appropriately emphasised as part of an overall text structure, comprehension will be facilitated. Application of this principle, while being ostensibly linguistic or psycholinguistic in nature, has implications for instructional design, in that instructional designers or instructional materials developers need to be concerned with linguistic factors, a skill not necessarily expected to be part of the instructional design armoury.

In analysing the research on typographical cueing, Stewart (1986) was able to suggest the principle that, if headings in text are chosen and arranged spatially and typographically to reflect the structural relationships in the text, comprehension of both the structure and the content of the text is likely to be enhanced. It is not often in an instructional text that the headings are arranged either spatially or typographically to reflect the structural relationship of ideas in the text. What is needed in practice is a greater correspondence betweeen the conceptual map and the typographical organisation of headings, a bringing together of notions of verbal and visual cueing allied with typography to help the reader comprehend both the structure and the content of the text. The starting point is the topic analysis: the end is a contribution not only to comprehension but to legibility, layout and readability.

Several areas of design concern are clearly brought together through consideration of the topic analysis as can be seen in the following illustration.



It should be noted, additionally, that consideration of structure and organisation issues also raises the questions of whether graphic organizers should be used and whether encouragement to the reader to utilise imagery abilities is appropriate. Two principles enunciated by Stewart (1986) are relevant.

> "If a graphic organizer is used to convey isomorphically the structure of ideas in text, then comprehension of the structure will be facilitated".
>
> "If the content of the text is related to spatial, creative, or problem-solving applications, the eliciting of imagery processes in its comprehension will be helpful".

Visual illustration

The second area of design concern which the instructional designer or instructional materials developer needs to consider is that of visual illustration. The observation by Perkins (1980) that practical picture making is a matter of recipe rather that principle is, unfortunately, too often correct in education. The basic misunderstanding of the use of visuals in learning probably lies in a belief that the message is in the visual. It has to be recognised that the message is not in the visual alone: the message is constructed in an interaction between the visual stimuli and the prior knowledge etc of the viewer. In education, too great an emphasis has been placed on the role of the visual and too little on the internal processing of the viewer (Winn, 1982; Salomon, 1979).

Duchastel's (1978, 1981) notion of attentional, explicative, and retentional functions of illustration appears to be well founded in the available theories of cognitive and visual processing systems, and is consistent with those of Levin (1979, 1981) and Levie & Lentz (1982). The idea that illustrations attract attention to materials is, intuitively, acceptable, although it would be more persuasive if it established that illustrations were the initial focus of attention. There is a real sense in which the text as a whole can either attract or repel, a feature which is related to congeniality, and it is very likely that illustrations play an

important role in this respect. Great use is made of explicative illustrations in instructional texts, teaching directly, explaining and clarifying, but the retentional role of illustrations tends not to be so widely considered, yet, as Duchastel (1981) has pointed out, any topic or domain of discourse has an internal structure which can be exploited in visual terms for the purpose of recall.

The instructional designer needs to be clear about the function to be performed by the illustration. Duchastel's (1980) reminder that it is the type of illustration and its relationship with the verbal component of the text which will make it useful or not, is a crucial consideration.

After reviewing the available research on visual illustration in text, Stewart (1986) proposed the following principles.

> "If illustrations are developed as an intergral part of the text design they will perform a motivational or attention-getting function".
>
> "If illustrations are designed to support organisational or conceptual aspects of a topic in text, they will facilitate comprehension".
>
> "If illustrations are developed to support the verbal argument of text, the integrity of the text will be enhanced if the illustrations are appropriately embedded, and alluded to, in the text".

Implementation of these principles requires the instructional developer to integrate text and visual development and to justify to printers or publishers why particular visual images not only need to be presented in a specified way but be included adjacent to identified parts of text. The relationship between words and pictures within the context of the structure & organisation of the text is what is at issue and the use of visuals in text cannot, therefore, be left to the discretion of editors, illustrators, or anyone other than the person with overall control of the text design process.

Readability, legibility and layout

Having given consideration to the structure and organisation aspects, together with the aspects associated with visual illustration, the instructional designer or instructional developer has to prepare the textual material, taking into consideration not only those linguistic aspects of text which enable idea units to be highlighted within the overall indication of structure, but the linguistic aspects which influence the affective and cognitive dimensions of readability.

Despite the widespread criticism associated with readability research due, almost entirely, to the misuse of and extravagant claims for readability indices, readability remains an important issue in the design of instructional text. From an analysis of research in the area of readability, Stewart (1986) has highlighted the relationship between readability and motivation, claiming that initial motivation can be heightened through the design of text which is, in an affective sense, 'readable', and that readability will, in turn, be improved because of the increased motivation. Considerable attention needs to be directed, therefore, to those aspects of the text which contribute to its affective dimension, such as typestyle and

layout. The affective aspect of readability can, potentially, induce emotional and motivational factors which are crucial to the arousing of interest and the focusing of attention which, in turn, are prerequisite to the facilitation of comprehension.

There is, too, a cognitive dimension to readability. A cognitive psychology framework for an understanding of the comprehension process and, thus, for readability, emphasises the psycholinguistic aspects of text as well as the reader-based sources of variance (Huckin, 1983; Chall, 1984). Stewart (1986) has suggested two principles of readability, viz

> "If the semantic and syntactic structure of the text is matched to the vocabulary and reading ability of the reader, there is more likely to be meaningful interaction between reader and text".
>
> "If the content and the psycholinguistic organisation of a text are related to the prior knowledge and cognitive ability of the reader, the readability of the text will be enhanced".

These two principles raise problems for educational practice due to the connection of content and style with reader ability and prior knowledge. Print is essentially a mass medium, yet these principles demand a considerable measure of individualisation. The application of these principles is probably best carried out by careful consideration of the group of readers for whom the material is being prepared, assessing as accurately as possible the abilities and prior knowledge which they have.

The designer/developer has to ensure, therefore, that the adopted style and the overall appearance of the material arising from the readability and layout considerations are conducive to the cultivation of motivation and, thus, comprehension.

Specific criteria of legibility becomes the final check with respect to physical parameters of the text to ensure that in the denoting of structure the typographical cueing is consistent with the other aspects of typography which, together, contribute to a well designed text.

Principles of legibility identified by Stewart (1986) and derived in relation to typeface, typestyle, size of type, length of line and interlinear spacing, and justification, arise primarily from text-based parameters and are affected only marginally by the input of the reader. However, although the use of typographical characteristics to affect layout is determined, in part, by physical parameters, there is also a potential contribution in respect of their cueing capacity. Relevant principles identified by Stewart (1986) are:

> "If the layout of a page is determined by the empirical evidence regarding typographic characteristics, the page will be more legible than if these characteristics are ignored".
>
> "If the typographic arrangement reflects the key features of the content of the text, comprehension of the structure of the text will be facilitated".

Since it is unreasonable to expect typesetters or printers to be able to analyse content and indentify key features, typographical cueing needs to be determined by the author or designer

of the instructional text, so it is important that such persons be familiar with typography and its manner of specification.

The emerging theory

From the discussion above, it is clear that the emerging theory of instructional text design involves:

(a) a topic analysis to determine the hierarchic relationship of ideas within the topic and the desired learning outcomes or objectives, from which can be determined

  (i) the kind of verbal cueing or pre-instructional strategy necessary to enable the reader to recognise the desired outcome and adopt an appropriate approach to the reading task;

  (ii) the kind of verbal cueing, reflective of the structure and organisation of the text, necessary for relevant schema activation;

  (iii) the basis for the structure of the text and, thus, the typographical cueing necessary to make the structure explicit; and

  (iv) the kind of questions which can be inserted in the text;

(b) a consideration of the linguistic aspects of text which

  (i) enable idea units to be highlighted within the overall indication of structure;

  (ii) influence the affective and cognitive dimensions of readability;

(c) a consideration of the role of visual illustrations as to whether they are

  (i) motivational, explicative, or retentional in intent;

  (ii) indicative of spatial relationships in the text; and

(d) a consideration of the physical parameters of the text to ensure that, in the denoting of structure, the typographical cueing is consistent with the other aspects of typography.

Although not particularly important, it can be noted that the issues (a)-(d) are, respectively, the design areas of structure & organisation, readability, visual illustration, and legibility, the resulting acronym for which - SORVIL - might usefully identify this approach to a theory of instructional text design.

It is not claimed that this is a complete theory of instructional text design, but it is offered as a contribution to such a theory. There could be other inter-relationships between the identified areas of design concern which need to be explored and there may well be other design areas which need to be taken into consideration.

The instructional designer/developer, in approaching the design of text, would normally develop the material in accordance with accepted instructional design procedures consistent with, for example, an educational technology approach to the design of instruction. However,

as Stewart (1985) has alleged, the principles of educational technology are not always explicit and there is a tendency for instructional designers or instructional media developers to adopt established procedures and practices without, necessarily, being able to justify these practices from more fundamental principles of educational technology. It is therefore likely that, in the development of instructional text, the same approach is being adopted.

In moving towards a theory of instructional text design which is based firmly on valid principles, it is hoped that instructional designers and instructional materials developers will, in the application of that theory, measure practice against principle and allow principle to determine practice.

As Carter (1985) has observed,

> ". . . the problem of producing usable written materials may have less to do with discovering a host of new principles than with learning to routinely apply these we already know". (p156)

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